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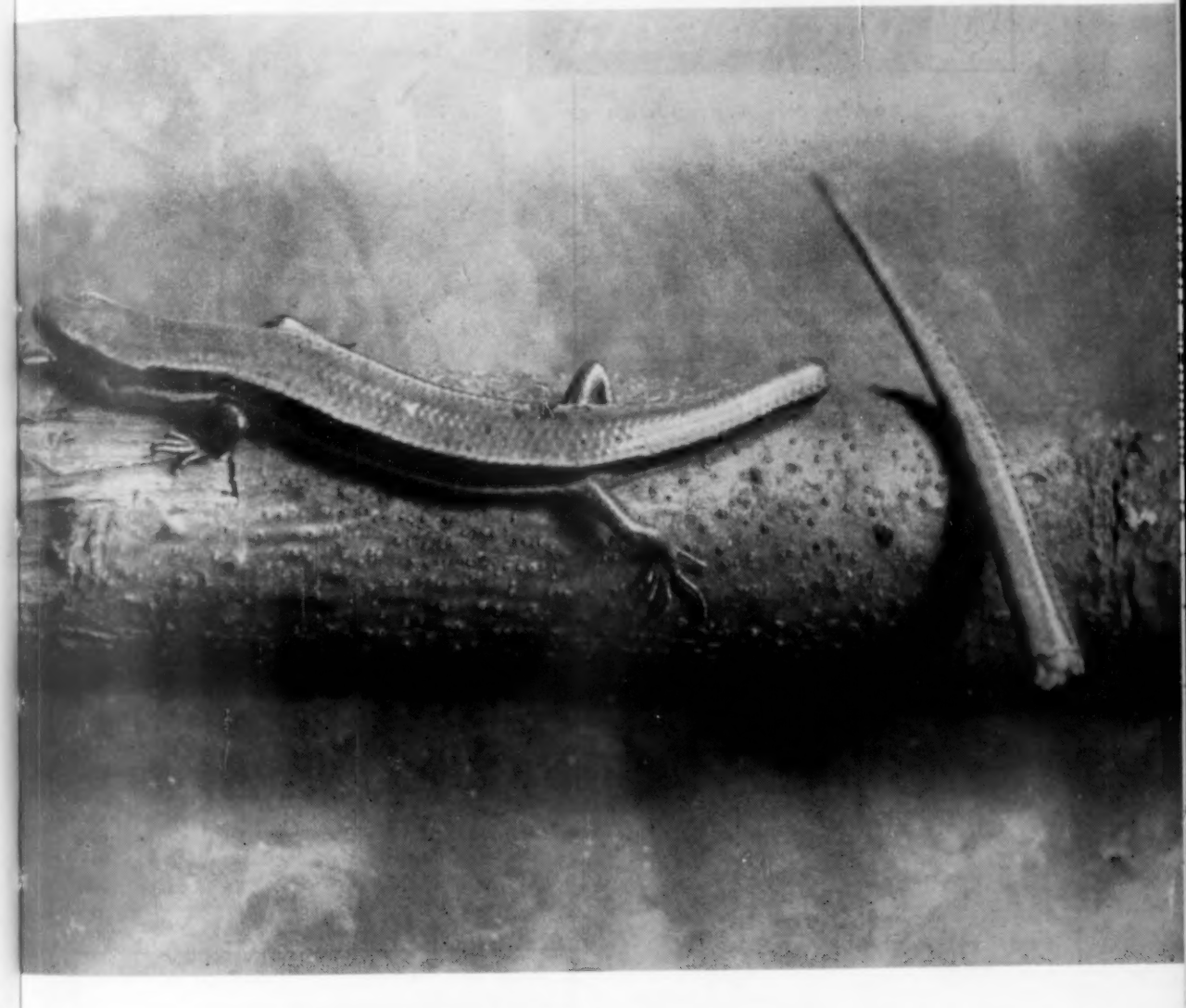
The American Biology Teacher

OCTOBER, 1956 VOL. 18, No. 6



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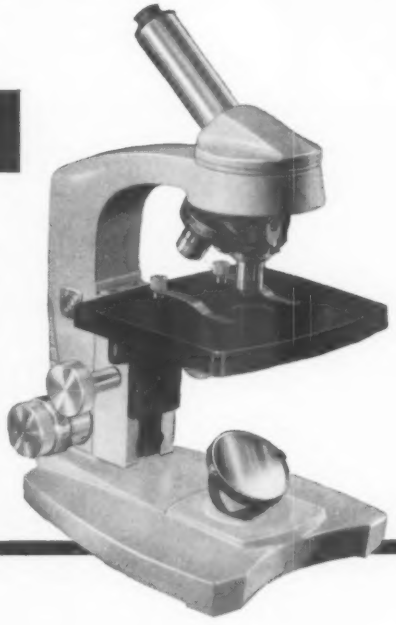

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Cover Photograph

The animal pictured is a rather rare lizard in Pennsylvania, the Coal Skink. It illustrates the biological oddity called "autotomy"—the loss of a body part for self preservation. When touched the skink sheds its tail and the would be captor stops to eat the tail while the skink escapes.

This particular picture was taken by James F. Nist, Greenville, Pennsylvania, with a Japanese Aeresflex 120 on Kodak Verichrome film. Two photofloods were used at night and a plus 3 portrait lens.

THE AMERICAN BIOLOGY TEACHER

Publication of the National Association of Biology Teachers.

Issued monthly during the school year from October to May. Entered as second class matter October 20, 1954, at the post office at Danville, Ill., under the Act of March 3, 1879.

Publication Office—Interstate Press, 19 N. Jackson St., Danville, Ill.

Co-Editors—RICHARD ARMACOST, Department of Biological Sciences, Purdue University, West Lafayette, Ind.; PAUL KLINGE, Howe High School, Indianapolis 1, Ind.

The Purdue University address will be the official editorial office. Manuscripts and all publication material may be sent to either of the Co-Editors.

Managing Editor—MURIEL BEUSCHLEIN, 6431 S. Richmond, Chicago 29, Ill.

Subscriptions, renewals, and notices of change of address should be sent to the Secretary-Treasurer, PAUL WEBSTER, Bryan City Schools, Bryan, Ohio. Correspondence concerning advertising should be sent to the Managing Editor.

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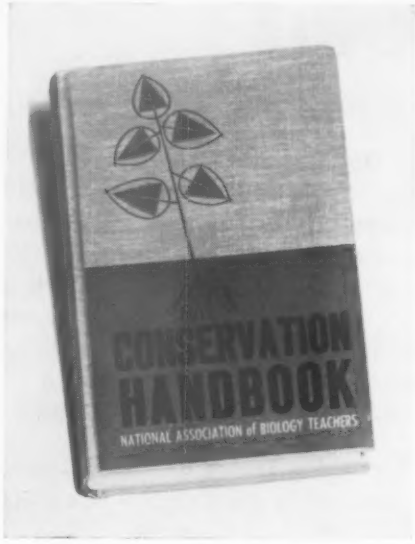

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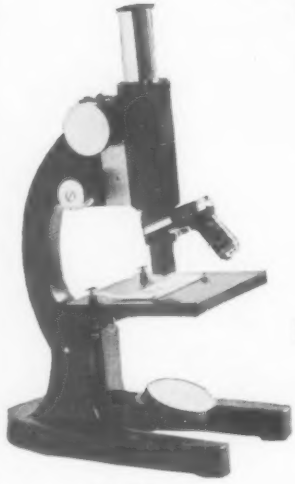

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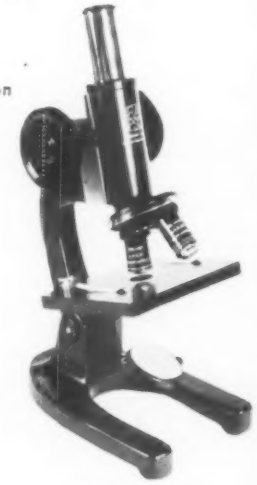

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Lesson of the Diatoms[1]

PAUL S. CONGER
Smithsonian Institution

The "Lesson of the Diatoms" presented objectively has much to offer, and could perhaps add more to the general biology course than is frequently realized. Its value consists in portrayal not only of their features, but of their place in Nature. It embraces relationships of most compelling interest and most profound significance, not to use superlatives inadvisedly. Show of their varied beauty, description of their unique characteristics, and statement of their commercial importance, which often comprise their classroom introduction, should not be allowed to obscure a still greater entity. Full worth of their acquaintance lies in abstract values beyond the bare confines of the subject. These concern vast ecological relationships, involving basic principles of biology. To miss such broader values is to miss an opportunity for larger benefits of which this "lesson" is capable.

The story of the diatoms can be as dynamic as are the surges of the lakes and oceans in which they live. To be effective it should be told in its entirety. Treatment of the diatom as a botanical type is not enough. It is inseparably associated with ecology and oceanography, geology and industry, fisheries and conservation. In this integral complex lie its excitement and its cultural value. Viewed thus it opens the whole vista of aquatic biology. A subject whose theme is so definitely ecological calls for presentation in well-coordinated perspective. The essence of ecology is its comprehensiveness.

A surprisingly large number of persons do not know that diatoms exist. People frequently ask: "What are diatoms? Are they living today? What do they do?" This unawareness is probably due to their microscopic character, and the indirectness of their effect upon us. Even among biology students there exists considerable unrealization of the scope of their significance. Yet diatoms are tremendously abundant, widely distributed, and of greatest importance in the balanced economy of the aquatic world.

There is small point in learning isolated facts about diatoms, however curious and interesting, if one fails to get a lasting, overall picture of the greater biological system of which they are such an important functional part. Details alone, about their types, structure, reproduction, habits of growth, etc., are not destined to make a student a better citizen, more capable of enjoying life, or potentially well informed, (traditional goals of education); he will neither be impressed with nor remember these, but a unified and well told story of the life of the diatoms and their interrelationships and role in Nature can, with benefit, do all of these. More of the philosophy as well as the facts of the subject could perhaps strengthen both its teaching and its comprehension.

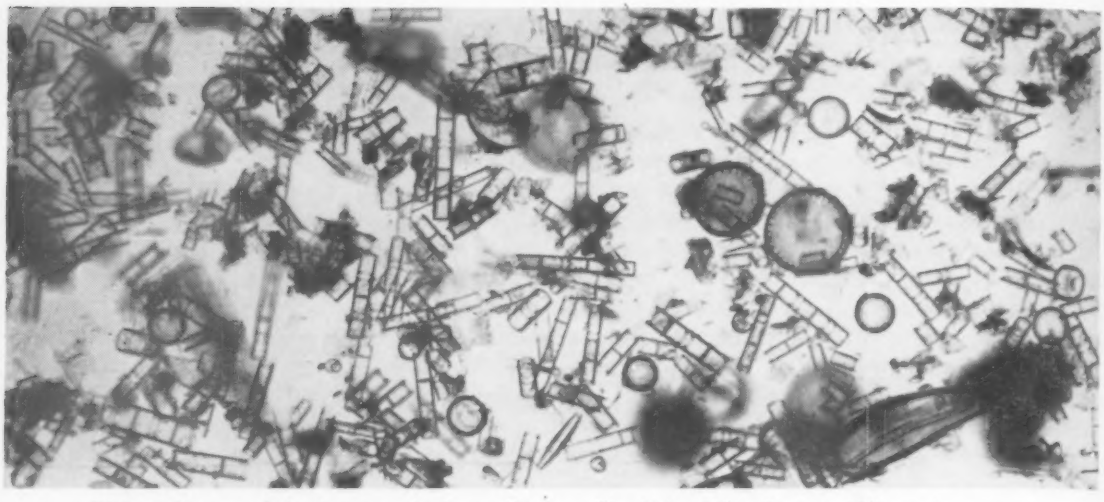
The facts of diatom character are simple, and hardly need repetition to biology teachers; objectives and manner of presentation might be enhanced. Toward the aim of a realistic ecological picture I propose to skip routine facts and pass on to less recognized relationships, and to append some possibly helpful teaching aids.

The accompanying general table of services rendered by diatoms will provide an introductory background for further discussion:

The several important services rendered by diatoms.

A. Physiological
   1. Fixation of silica—ultimately diatomaceous earth
   2. Photosynthetic conversion of chemical solutes into tangible protoplasmic substance
      a. Basic food of marine animal life, in the "food cycle" ("food chain")
      b. Sedimentation and deposition as rich organic muds
   3. Production of oil—a probable source of petroleum

[1]Published with the permission of the Secretary of the Smithsonian Institution, United States Museum, Washington, D. C.



Rich sediment of freshwater plankton diatoms. Big Lake, Vilas County, Wisconsin. x 80

4. Synthesis of Vitamins A and D—stored in excess in livers of certain fish, they become commercial source of these vitamins

B. Ecological
   1. Maintenance of chemical equilibrium and stability of aqautic environment, by
      a. Fixation and removal of pollution and waste concentrates
      b. Prevention of dispersal of pollutants and solutes—by localized deposition of their compounds
      c. Modification and adjustment of pH (through reduction of solutes and aeration-respiration)
   2. Aeration (*in situ*) of the water
      a. Vital in periods of stagnation—when mixing and exchange with the atmosphere is low
      b. Under the seal of an ice cover

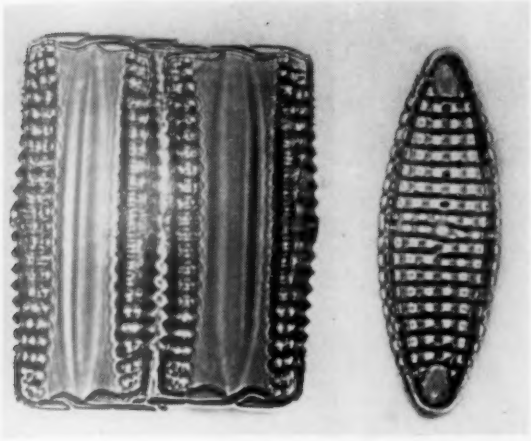
C. Incidental
   1. Absorption and dispersal of light
   2. Coloration of water—by presence of their pigments
   3. Purification of water—by fixation and removal of dissolved substances
   4. Deposition of slime, and production of protective covering—(on rocks, whales, algae, and many surfaces)

Diatoms perform several obscure but vastly significant functions in Nature which constitute their greatest usefulness, but because these are subtle and unobstrusive they are largely overlooked. They need to be called to attention to give a true picture of the role of these microscopic plants.

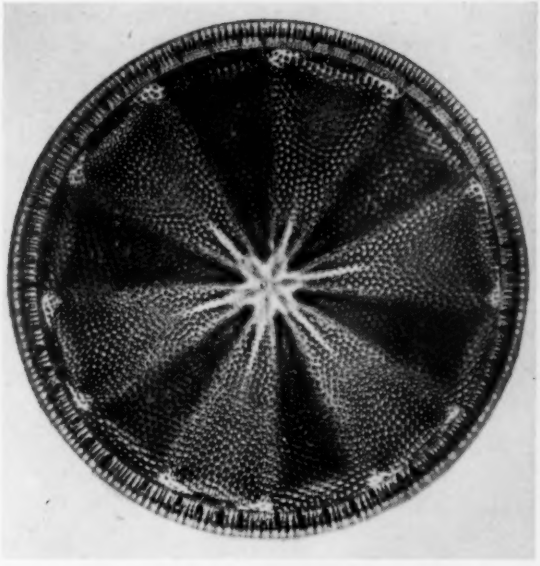
Mention of "economic importance of diatoms" usually calls to mind their more familiar role as food of marine animal life, ("Grass-of-the-Sea"), and the commercial uses of diatomaceous earth. Their place in the general economy of Nature, however, as living organisms, is of far greater scope; to it their food role is but incidental. It is in this natural connection as a biological factor that the usefulness of the diatom is perhaps most neglected, and should be emphasized, not to stress the importance of the diatoms but to give a clear picture of the whole biological system.

The diatom's greatest service is inherent in its plant character as a photosynthetic agent. In this capacity it is the chief plant life of vast expanses of the open oceans, along with the Flagellates, and of many lakes and other waters. Here, in the aquatic world, it is the counterpart of the land plants in synthesis of organic substance and in gaseous exchange (oxygen—carbon-dioxide balance).

Our concern is not in a mere reiteration of this time-worn photosynthetic function, but in an inspection of the suitability of the diatom as a mobile photosynthetic agent, the nicety of this arrangement, and the significant circumstances which result. Wherever diatom cells happen to be drifting they convert chemical solutes into tangible protoplasmic substance that can either be consumed or sedimented to the bottom to build up rich organic muds;



Glyphodesmis margaritacea Cast. Valve (or face) view, and girdle view of two cells showing overlapping structure of girdle. x 600.



Actinoptychus heliopelta grun, Maryland. x 225. Fossil marine bottom diatom.

they absorb carbon-dioxide and liberate oxygen, aerating the water in depths out of access to the air; in so doing they contribute to adjustment of the pH; in fixating dissolved chemicals they remove excesses of nutritive and undesirable substances and maintain a chemical equilibrium favorable to the life of the aquatic community; incidental to their metabolism they manufacture oil and vitamins.

The student who receives an understanding of these profound relationships will not only perceive the interesting facts about diatoms as a type of plant life, but will have had opened up to him a whole broad perspective of the intricate balance of the aquatic world.

Though our purpose here is purely with the academic and biological aspects of the subject, these relationships all take on highly practical impacts. Just to divert momentarily and mention some of these will serve to illustrate how intimately bound up all things are with all other things, although we are often unaware of the connections. With accelerating interest in all aspects of the science of the oceans, the utilization of resources of the sea, special products from the sea, concern over world population and food supply, better fisheries management, possible dumping of atomic wastes at sea, pollution control, and better water supplies, the diatom as a basic metabolic agent intimately associated with all these matters naturally assumes increasing prominence. Its relation to the first four, as an original food material, is self-evident. Relative to the fifth, its ability to absorb and store radiation products to many times its natural content, and transmit them in above normal quantities to fish that use it as food, whence these products can find their way to human consumption, is a matter commanding inquiry. In this process diatoms can act both as a tracer for the course of radioactive materials and as an accumulator of them. The diatom's connection with the problem of pollution is similarly dual in character. The inability of all but a few diatoms to live in highly polluted water makes their presence or absence a useable indicator of excessive pollution, but even more importantly they are a very active and effective agent in clarification and purification of waters by absorbing and removing pollution products.

Returning to the role of the diatom as a mobile photosynthetic agent, its high efficiency may be attributed to its minute size, its relatively large absorptive surface, its ability to reproduce quickly and to build up a large population in response to influx of food material, and to its hardy resistance. Its hardiness deserves special mention, for upon this probably depends its dominance of the oceans and its wide distribution in all types of aquatic conditions. Its hardiness would seem to be related to its utilization of silica as a building material in its cell wall, its development of

yellowish-brown pigments, and its manufacture and storage of oil as a reserve food, plus perhaps less evident characteristics peculiar to its physiology. Accordingly, among its more than 250 genera and over 10,000 species it has evolved forms that can withstand most extreme conditions and live over the widest range of environmental habitats, more than almost any other living form. These include such conditions as surviving freezing and long periods of desiccation, dwelling in Arctic and Antarctic waters, glacial pools, high alpine altitudes, extremes of pH, and the almost boiling waters of hot springs.

It is difficult to realize the magnitude of the relationships effected by them unless one can imagine the water as being filled with diatoms. And so it virtually is. The efficacy and flexibility of their function depends upon their universal presence in every aquatic situation, and readiness to utilize the available dissolved food materials. It is true that diatoms or their spores are practically everywhere where water can support life, on every inch of bottom, on all submerged surfaces, floating in nearly every drop of water. Their power, like that of all minute forms, resides in their prodigious numbers. They are immersed in the water whose solutes they absorb and their ability to do so depends upon the thoroughness of their surface contact with the solution.

Better visualization of the potency of this mechanism for transformation of dissolved materials can be obtained from a specific concept of the abundance and dispersion of diatoms. Conventional statement of population density in such unwieldy terms as thousands to millions of cells per liter tends to be vague and incomprehensible. A clearer mental picture is had by reducing this to simpler terms. Suppose, for instance, a population of one million cells per liter. This would be one cell per cubic millimeter, or, the cells would average about one millimeter apart. Cells in populations greater or less than a million per liter would be respectively closer, or slightly further apart.

Such a representative example of abundance and relative proximity of the cells affords a clearer idea of their potential contact with, and absorption of, solute from the medium about them.

Ecologically, the significant effect of this efficient screening process by these universally distributed, innumerable, minute plants is the rapid conversion of most of the dissolved material into edible or sedimentable substance in rivers, river mouths, or a near-shore coastal belt, preventing this valuable material from being scattered far to sea. As a consequence of the dense microscopic life and rich organic sediments of this near-shore area, fish and other large forms are attracted to it as one of abundance of food, rendering this littoral or coastal region one of the richest, most diversified, and most concentrated of all life zones.

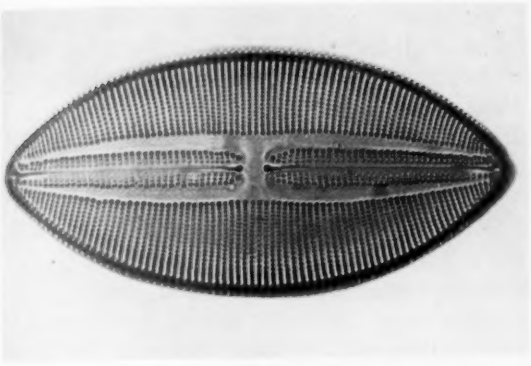
The benefit to us of all this is that the fisheries and many other sea resources are held within reasonable proximity of the land where they are thus most accessible to us. Besides, a certain relatively small but appreciable amount of the heavy loss from the land through erosion, pollution, and other wastes, can be recoverable and returnable to the land by means of washing up on beaches, building up of sediments, emergent vegetation, guano, and fermentation gases.

We should recall in summary that though we seem far removed from discussion of the diatom itself, it is because of the hardiness and facile character of this minute plant, which dominates the oceans and many other waters, that these beneficial and dynamic relationships prevail.

A well-portrayed knowledge of the interdependence of these many factors should give the student a more appreciative sense of the biological world, and a perhaps more farsighted and practical outlook toward such seemingly unconnected subjects as land management, pollution and flood control, forest policy, industrial waste, water resources, and conservation in general.

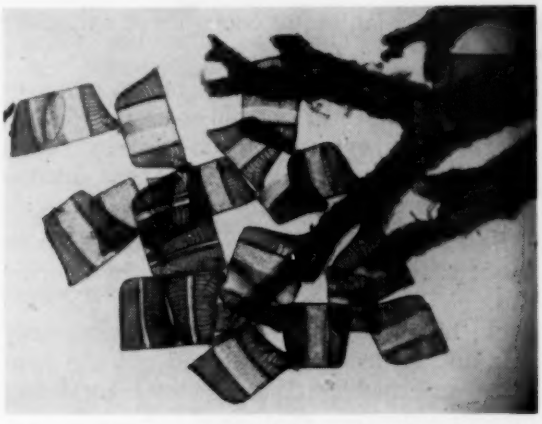
In coastal waters and tributaries, as well as in the open ocean the diatoms are of a quiet but inestimable service, a basic producer of food and organic substance, a great equalizing and stabilizing factor, a leveller of pH, a force in the aeration and purification of water, and a conservation agency in general, purely by virtue of their existence.

This could be the "lesson of the diatoms." Suggested list of materials for representative presentation of the subject:—

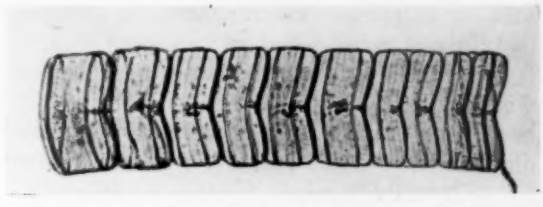


Navicula Lyra Ehr. Marine. x 500 diameters.

1. Slide of marine bottom diatoms
   (To show dominantly Centrate or Radiate forms—round and angular diatoms, such as *Coscinodiscus*, *Actinoptychus*, *Auliscus*, *Biddulphia*, *Pleurosigma*, *Campylodiscus*, *Surirella*, etc.)
2. Slide of freshwater bottom diatoms
   (Dominantly Pennate, bilatteral, and linear types—such as *Navicula*, *Cymbella*, *Eunotia*, *Epithemia*, *Pleurosigma*, *Surirella*, *Cymatopleura*, etc.)
3. Slide of marine plankton diatoms
   (Showing the light, thinly-silicified cells, adapted for floatation – *Chaetoceros*, *Rhizosolenia*, *Biddulphia*, *Ditylum*, *Thalassiosira*, *Thalassiothrix*, *Eucampia*, etc.)
4. Slide of attached, colonial forms
   (Filaments or ribbons, zig-zag chains, fan-shaped colonies—such as *Melosira*, *Grammatophora*, *Licmophora*, *Isthmia*, *Biddulphia*, *Achnanthes*, *Rhabdonema*, etc.)
5. Piece of Seaweed with diatoms attached (dry), or slide
   (*Isthmia*, *Licmophora*, *Grammatophora*, *Hyalodiscus*, *Cocconeis*, *Synedra*, etc.—showing dense abundance of growth on submerged surfaces)
6. Lump of diatomaceous earth
   (Exhibiting powdery texture, whiteness, lightness of weight and porosity, floatability, chemical inertness, and such physical qualities upon which its usefulness depends)
7. Sample of living diatoms—marine or freshwater, or both
   (Illustrating live cellular structure—chromatophores and pigment, nucleus, oil-droplet food reserves, and locomotion—in large types of *Navicula Pleurosigma*, or others)



Colony of diatoms (Isthmia nervosa Kuetz.) Growing on seaweed. x 80.



Typical attached colony with stipe. Achnanthes brevipes C. Agardh. x 100.

Sources of Material.

Diatoms are widely prevalent; securing some kind of material is seldom a problem. Diversity may require supplemental sources. Local collecting saves on budget and introduces one to natural habitats. Almost every community has some likely collecting place—lake, river, seashore, springs, pools, fountains, fish ponds, or marshy areas. Lacking such, the school aquarium may serve, or, for last resort, a jar of silver polish can both provide their shell remains and illustrate a commercial use.

There are the biological supply houses—Turtox and Wards, among others, offer both mounted slides and raw material.

Collecting is simple and rewarding:—

Plankton. This type of collecting need not be abandoned for lack of an expensive silk plankton net. Instead, pour several pails of lake or seawater through a 10-inch square of old nylon hose supported on a ring or screen. Organisms retained by the nylon mesh can be

rinsed into a jar, in just enough water to effect rinsing.

Bottom diatoms. Use any means of skimming the surface of bottom sediment—dipper, weighted can, or dredge made of six-inch piece of pipe with one end closed. These diatoms are of course, mixed with mud and debris.

Beach sand. Rich diatom collections can be washed from below-tide sand, by sieving through fine screen that will hold the sand back; by differential settling—stir vigorously in a bucket, let sand settle and quickly pour dirty supernatant, diatom—containing water into separate container. Repeat.

Epiphytic diatoms. A most gratifying and easy way to get rich collections with little sand or extraneous matter: squeeze or wring handfuls of pond-weed or sea-weed, bearing fuzzy or slimy attached diatom growth, into a container. Even dry seaweed picked up on a beach may be profusely covered with attached diatoms. One could scarcely go to less effort for so lucrative a result.

For this collecting it is not even necessary to get one's feet wet or go in a boat. Appartus can be thrown out and pulled ashore. Pondweed or seaweed may be obtained with a rake, or a rake on a rope. It might be fitly said the best source is resourcefulness. Smoothly cut, nested, vegetable cans make compact field equipment and excellent washing and settling containers.

A field collecting experience, with realization of the prolificness of this microscopic life is perhaps more impressive and instructive than any amount of laboratory study of already secured material. The student who sees the teeming life in his own collection will not soon forget it, and will in a matter of moments, get a panoramic picture of a whole biological system. Even a wet footprint may be a thriving aquatic community.

Preparation of Slides.

Diatoms are simple and satisfactory to prepare, but since they require treatment with dangerous acids this should not be attempted with improper facilities or left unsupervised to careless individuals. Every precaution should be strictly adhered to avoid unhappy results.

Preservation of raw material is in 5% formalin. Plankton is not treated further as the delicate shells disintegrate. It is mounted as is.

Tò mount, wash out all salt and formalin by several decantations; spread a drop on a coverglass, allow to dry, moisten with xylol, drain the excess and quickly invert over a drop of warm balsam (or other mountant) on a slide.

Cleaning bottom or attached diatoms: cover a few drops of material in a small beaker with nitric acid (or "aqua regia"—3 parts hydrochloric, 1 part nitric acid); boil gently, under a fume hood, till color leaves; wash out acid by several decantations; preserve in 35% alcohol or formalin. Mount as above.

(*Precaution.* Do not perform acid treatment in a narrow test tube—it will froth over suddenly. A test tube of large (1 inch) diameter is suitable, using small amounts. Use holder and face mouth of tube away from operator.)

Preparation of fresh material, or before preservation, is preferable. A better balanced preservative is: 50% alcohol, formalin, acetic acid, 6-3-1 parts respectively.

Sources of Information.

A good general understanding of the nature of diatoms and their function is all that need reasonably be expected or desired in a general biology course, and it would be gratifying if every course afforded even this much. More detailed information is practically beyond the time and usefulness of the average high school or college student.

General information as mentioned above can be found in varied extent in general biology and botany texts, books on pond life and aquatic biology, with an excellent account in the Encyclopedia Britannica.

Ward and Whipple's "Freshwater Biology" gives good information with keys for classification. Much fuller information can be obtained from texts on Algology, of which excellent ones are Dr. G. M. Smith's "Freshwater Algae of the United States" (McGraw-Hill Book Co.), and his "Cryptogamic Botany." F. E. Fritsch's "Structure and Reproduction of the Algae" (MacMillan Company), has almost fuller and more technical information than usable in high school, but touches little on classification. Dr. Josephine Tilden's "The Algae and Their Life Relations, Fundamentals of Phycology." (Univ. Minnesota Press, 1935), is another good source. It, with Ward &

Whipple, and Smith's books are good for classification, having keys and illustrations. All these works give supplementary bibliography.

As to classification, diatoms are rather readily and satisfactorily identifiable to genera, but it is wise in general classes not to attempt specific identification except of some large, common forms which are easily placeable. Identification to species of the many smaller and very similar forms is the realm of the specialist and requires a considerable library of scarce and costly works. It is beyond the time and usefulness for general biology work.

A paper of mine, "The Diatoms, Their Most Important Role" (Scientific Monthly, Nov., 1951) now out of print and available only in libraries, elaborates on the various aspects of diatom usefulness mentioned here.

Some Variations in Biology Experiments[1]

N. E. BINGHAM
Professor of Education
University of Florida

Experiments and demonstrations are used in many different ways in the classroom. Three effective uses are: (1) presenting experiences in the use of a scientific approach to the getting of information and checking in its validity; (2) focusing attention upon facts essential in the developing of concepts; and (3) developing appreciation and interest in the areas being taught. If experiments are to be used for these three ends, then it is important that the students be involved in planning them, in doing them, and in considering what the experiments really mean.

Children as well as scientists gain information from many sources. Many of the ideas which they gather, though based upon observations, may not be true. If children are to have dependable answers, they need to have ways of verifying the information they accept and relating this information to other facts that they know. They can speculate as to why it is true and how it came to happen.

There are two ways that they may use experiments to verify this newly acquired information. In the first place, they may speculate as to what makes the thing happen and devise experiments to answer this question. In the second place, they may explore in their thinking what other things must also be true if this newly acquired information is true and then use experiments to check and see if these consequences are true. To illustrate these two ways of using experiments, I have chosen some experiments in connection with photosynthesis, osmosis, the balance among living things, lake stratification, and the buffering action of physiological salts.

I. Oxygen Is Liberated During Photosynthesis

From their reading, from observing plants in a well-lighted aquarium, and from many other sources, children gain the idea that oxygen is liberated through photosynthesis. This is a rather basic concept in understanding the interrelations among living and should be demonstrated if possible. How can one show that oxygen is liberated during photosynthesis? One might confine some plants under ideal growing conditions with plenty of light and in some way measure the amount of oxygen that was in the container to begin with, and then again after the plants had been exposed to light for considerable time. To do this, one might confine the plants in some other gas, but a difficulty in this connection is that plants, like animals, should have oxygen available to them at all times. Hence, this procedure would not provide the ideal conditions necessary. Again, no gases should be used which might poison the plants.

Perhaps there is some percentage of oxygen required that could be easily measured. A splint will burn in an atmosphere that contains approximately 15% of oxygen and will be extinguished in an atmosphere that contains less than this amount. Why not use this level

[1]Paper presented to the National Association of Biology Teachers Meeting, Atlanta, Georgia, December 27, 1955.

of oxygen as a critical point to determine whether or not oxygen is liberated during photosynthesis? We could do this if we could dilute the gas present in the container by ¼ with some other inert gas not harmful to plants, thus reducing the percentage of oxygen in the air from around 20% to around 15%. This can be done easily by using a gallon jar and mixing a quart of carbon dioxide with a gallon jar of air.

So, to illustrate that oxygen is liberated during photosynthesis, place healthy cuttings in water in each of two gallon jars. Mix one quart of carbon dioxide with each of the gallons of air. After mixing, test the gas in each gallon jar with a burning splint to show that it will not support combustion. Seal each jar tightly, place one in continuous high level of illumination and place one in a dark closet. On the succeeding day test the gas in each jar to see if it will support the combustion of a burning splint.

II. Experiments with Osmosis

Osmosis is diffusion of a fluid through a membrane with the diffusing material moving more rapidly from the side where it is more concentrated. If this definition is true, then we should be able to set up a situation which would clearly show it. Since sugar is frequently used in osmosis demonstrations, children often confuse the density of the sugar solution as a determining factor rather than to focus their attention upon the fact that it is the water which goes through the membrane, and that the water goes from the place where it is more concentrated to where it is less concentrated.

To emphasize that density has nothing to do with osmosis, find some substance to mix water which is less dense than water, but which will not go through the membrane as readily as water. Ethyl alcohol is a good substance to use in this connection. Make "model cells" of bottles. Fill the bottles with a mixture of water and alcohol, seal with a membrane, and immerse in a vessel of pure water. If the above statement regarding osmosis is true, then water should move into the bottle stretching the membrane, that is from the side having pure water into the less dense mixture of alcohol and water faster than in the reverse direction.

As in the case of liquids, gases also diffuse through a membrane and some gases diffuse through a membrane faster than others. Lighter gases with smaller molecules, as hydrogen, will move through faster than heavier gases with larger molecules, such as carbon dioxide. To demonstrate the diffusion of gases through a membrane, seal air in a porous cup by means of a rubber stopper, a glass tube and a colored liquid. Then if a light gas is placed over the porous cup, bubbles of air should come up through the liquid, as the light gas should move into the porous cup faster than the air should move out of it. If a heavier gas is placed around the cup, the liquid should raise in the tube, as the air should move out of the porous cup faster than the heavier gas moves in. Set up an apparatus to see if these consequences are true and account for what happens.

III. The Balance Between Respiration and Photosynthesis

Frequently teachers and children set up so-called "balanced aquaria," and since they succeed over long periods of time, in keeping both plants and animals alive in such aquaria believe that they have demonstrated adequately the balance that exists among living things. Most directions for setting up such aquaria stress that there must be both plants and animals in an aquarium and children may unthinkingly draw the conclusion that the balance is between plants' "living stuff" and animal "living stuff." The fact that gases are at all times exchanged with the atmosphere at the surface of the aquarium may be entirely ignored.

What things are essential if the plants and animals are to thrive in an aquarium? Each must have food, each must have oxygen, each must be at a suitable temperature, each must have water, each must dispose of waste, et al. Can green plants live without animals? Can animals live without green plants? Is the balance of an aquarium between the plants and the animals there, or is it between certain processes which are carried on by the plants and the animals? If it is between the processes rather than between the plants and animals, then we should be able to set up balanced aquaria with plants only. Since animals cannot carry on photosynthesis, then animals alone should not be able to live in an aquarium,

for they would suffocate or starve. By sealing the various aquaria we set up, we can eliminate the error of diffusion of gases through the surface. Such sealed aquaria or terraria may be thought of as microcosms, or small worlds, and by setting up a variety of microcosms and observing them over a period of time, we can account for such things as: (1) the oxygen used by both green plants and animals in the process of respiration, (2) the food used by the animals and green plants in respiration and assimilation, (3) the carbon dioxide used by the green plants in photosynthesis, (5) the chemically-bound food energy used by both the green plants and the animals, and (6) the conditions under which respiration and assimilation in both green plants and animals are compensated by photosynthesis in the green plants.

To gain information regarding these interrelations, have children set up sealed microcosms and account for what takes place in them. They may set up an aquaria microcosm with both plants and animals, a terraria microcosm with both plants and animals, an aquaria microcosm with plants only, a terraria microcosm with plants only, an aquaria microcosm with animals only, and a terraria microcosm with animals only.

IV. Lake Stratification and Lake Tu nover

This phenomenon of the stratification of fresh water lakes during the summer time and of the turnover which occurs before the surface freezes over with the approach of winter has much to do with the living things we find in lakes. When the lake is stratified in summer, the warm water is on top and since the warm water does not dissolve as much oxygen as cold water, it means that the quantity of dissolved oxygen at the bottom of the lake is lessened. Consequently, some forms of life will be limited by the lack of oxygen at the bottom of the lake. This is clearly illustrated in the limited flora and fauna found in bogs. With the freezing of the lake in winter, the additional absorption of oxygen in the surface is cut off; hence, at this time too, there is a limited supply of oxygen available for living forms in the lake.

If water did not expand as it cools from 4° centigrade through the freezing process, lakes would freeze from the bottom up rather than from the top down and hence many of the forms in the lake would be killed. However, water expands when cooled from 4°C to 0°C and also expands when heated from 4°C up to the boiling point and vice versa, with the result that as water freezes a layer of ice forms like a blanket over the surface of a lake. In the fall as the air gets cooler, the surface of a lake cools. Water which has been the the surface keeps settling deeper and deeper until the time when the surface temperature reaches the temperature at the bottom of the lake. From that time on the water continues to turn over from top to bottom until it cools to 4° centigrade. At these cool temperatures, water dissolves a much greater amount of oxygen than at high temperatures and hence there is an abundant supply of oxygen in the water of the entire lake prior to the winter freeze-up.

This lake stratification and turnover can be demonstrated by using a tall graduated cylinder or some similar container, placing hot water in the bottom of it, and then placing cold water beneath the hot water by means of a funnel and glass tube to illustrate the stratified condition in the summer. Color may then be added to the hot water to show the stratified condition. Next, what happens in the fall of the year may be simulated by cooling the surface of the water in the graduated cylinder with crushed ice, demonstrating by the turbulence and movement of the colored water that the lake progressively cools deeper and deeper and eventually turns over.

V. The Buffering Action of Phosphate Salts

Wide changes in the acid base contents of the fluids of living organisms would quickly result in death. It seems important to dramatize the way various salts, particularly phosphate salts, act in buffering or limiting the changes in the pH or acid-base, condition of the body fluids. Were it not for this buffering action, the carbonic acid added to the blood by the body cells during exercise would cause serious disturbance. Likewise, the acids or bases absorbed into the body following meals rich in acids or bases would also upset the body metabolism. The monobasic and the dibasic phosphate salts react with acids or bases which may come into the body, thus limiting the change that would occur in the pH or the acid-base condition. This can be demonstrated by using an indicator that will show neutral, acid, and base condition. Com-

pare the amounts of acid and base required to produce a color change in solutions of phosphate salts with that required in the same amount of pure water.

To demonstrate the buffering action of phosphate salts, treat solutions of these "buffer salts" with measured quantities of acid and alkali and compare with the action in plain water. Use (a) plain water as a control or basis of comparison and make up three solutions as follows: into 200 cc of water dissolve (b) 1 teaspoon of dibasic sodium phosphate (Na_2HPO_4); (c) 1 teaspoon momobasic sodium phosphate (Na_2HPO_4); (d) ½ teaspoon each of dibasic sodium phosphate and monobasic sodium phosphate.

As an indicator use extract of red cabbage. (Boil the leaves in water to extract the red juice.) When acid, this extract has a pink color; when neutral a blue color; and when basic, a green color.

Prepare four sets of three containers each, using 100-cubic-centimenter beakers or small tumblers or bottles (all of the same diameter, to make comparisons of colors easier). Place 50 cc of water in each beaker of set a; 50 cc of dibasic sodium phosphate solution in each set of b; 50 cc of monobasic sodium phosphate in each of set c; and 50 cc of the mixed dibasic and monobasic sodium phosphate in each of set d. Add 10 cc of the cabbage extract to each vessel.

Compare the colors of the 4 solutions. Note that some are slightly alkaline, some are neutral, and some slightly acid. With an eye dropper, add a half-and-half mixture of hydrochloric acid and water a drop at a time to one of the beakers having water until it is a pink color (two drops should be enough). Add sufficient base, a solution of sodium hydroxide or ammonia, to the second water beaker to give a barely green color (two drops should be enough). Likewise, add enough drops of acid to one of the vessels in each of the other three solutions to give the same pink color as shown by the acid-water solution. Then add enough drops of base required by each of the remaining 3 solutions to give the green color of the basic water solution. Compare the number of drops of acid and base necessary to shift the acidity or alkalinity in each of the solutions the same degree as two drops would shift it in the water solutions.

Another Use for Aluminum Foil

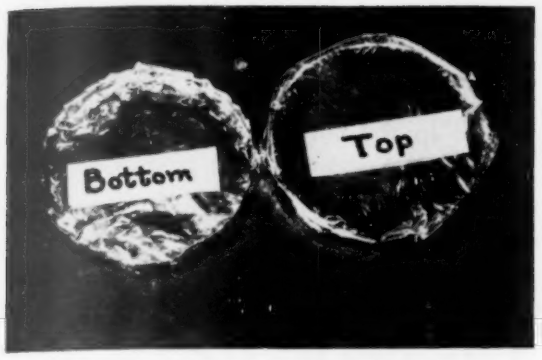
DAVID L. FAGLE
Science Teacher—Knoxville, Iowa

New developments in the field of science are usually the result of years of careful investigation. Sometimes ideas are so simple that they may be overlooked by the very intellectual minds of the inquisitive scientists. Using aluminum foil for wrapping frozen foods, for baking pies, or for cooking out-of-doors is not unique, but using aluminum foil for petri dishes is different.

In high schools where funds are limited, petri dishes made from a heavy type of aluminum foil have the following advantages over the normal glass petri dishes: (1) there is no breakage, (2) they are very cheap to make, (3) they can be made by students, (4) they withstand either sterilization in an autoclave or a hot air oven, (5) they are easily disposed of if they contain pathogenic organisms, (6) they may be cleaned and reused many times, (7) the medium may easily be removed from them and placed on Saran-wrap to facilitate counting colonies, and (8) they give no storage problem because they can be discarded at the end of the teaching unit.

Making petri dishes, shown in the picture, is a very simple procedure. Cut a five inch square of extra heavy aluminum foil and press it into the center of a glass petri dish, which may be used as a mold. With your fingers mold the aluminum foil to fit the inner-surface of the glass petri dish. Trim off any excess aluminum foil even with the glass using a pair of small scissors. Remove the aluminum foil from the mold, and you have the bottom half of the petri dish. To make the top of the petri dish, cut another five inch square of extra heavy aluminum foil and mold this around the outside of the same glass petri plate. Trim off any excess aluminum foil with the scissors. Remove this aluminum foil petri plate lid from the mold and place it on top of the prepared bottom. The aluminum foil petri dish is now ready for sterilization and use.

There are many types of home made supplementary equipment that may be used in



Aluminum Foil Petri Dish

high school science. Aluminum foil petri dishes are just one of these supplementary aids. Materials of this type will allow classes to study areas not usually studied due to a lack of equipment.

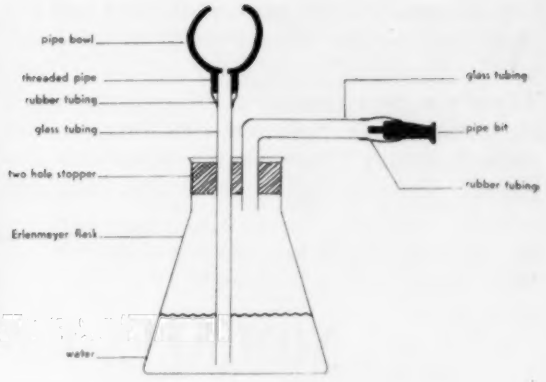
Hooka Hoopla

FRANK E. WOLF
Plymouth Teachers College
Plymouth, New Hampshire

During a unit on health, questions were raised concerning the effectiveness of filter-tip cigarettes and the relative quantities of presumed harmful ingredients in various smoking media. A hooka was devised and used to demonstrate the ingredients of tobacco smoke.

The results were surprising to this science teacher and the class. We were shocked by the large quantities of objectionable material precipitated in and the foul odors which emanated from the hooka. There was an exceedingly fast discoloration of the water and glass and rubber tubing. The rubber tubing rapidly lost its elasticity, becoming brittle and subject to cracking.

Although we had explored the stains produced by blowing smoke through a cloth, we were particularly impressed with this demonstration, illustrating the objectionable materials taken into the body during smoking. One could readily imagine the bronchi coloring, caking, and losing elasticity as did the rubber tubing. It must be noted, however, that judgments relating the demonstration to the body were reserved, based on our limited experimental data.



A pipe bowl was secured by sawing off a pipe stem at the base of the bowl. The hole at the bottom of the bowl was enlarged by drilling. Into the hole, a two inch length of threaded pipe was introduced and sealed with putty. A twelve inch length of glass tubing, slightly smaller than the inside diameter of the threaded pipe, was fitted with a short piece of rubber tubing pulled back from one end. The glass tubing was inserted into the threaded pipe and the rubber tubing pulled up over the threaded pipe. The sub-assembly was fitted into one of the holes in a two hole rubber stopper.

Into the other hole of the stopper, a length of glass tubing, bent at a right angle, was inserted until it protruded slightly. A piece of rubber tubing was fitted to the long end of the glass tubing. The bit from the discarded pipe stem was fitted into the rubber tubing. The stopper was then introduced into a liter Erlenmeyer flask.

Various tobaccos were smoked: pipe, cigarette, and cigar. Measured quantities of water were used with each type of tobacco. Each sample of water was placed in a small flask for comparison with a control and other samples. A colorimeter may be used to measure color intensity, using one of the three samples as a standard and comparing it to the others.

Smoking cigarettes in the pipe bowl was no problem as the paper wrappers were removed. This was done to keep the condition of the tobaccos constant. There was no appreciable difference between the various tobaccos used as indicated by the water samples collected.

A cigarette holder was substituted for the pipe bowl in the second phase to use with whole cigarettes, both filter tip and plain. There was no appreciable difference between the water samples collected from filter tips and plain cigarettes. There was no appreciable difference between the water samples collected from wrapped and unwrapped cigarettes, indicating that the cigarette paper contributes little to collection of tars from the cigarettes. It was assumed that the water did not contribute to the collection of tars and other ingredients.

NOMINEES FOR 1957 OFFICERS

The National Association of Biology Teachers

In accordance with established procedure, this year's nominating committee has prepared a slate of candidates from persons suggested by NABT members and officers. Biographical information about the candidates is presented in this issue of the ABT, including the following, in order: name, present position, higher education, experience, NABT service, activities in other organizations, and publications. Ballots are being mailed to all NABT members.

Candidate for President-Elect

Irene Hollenbeck

Assistant Professor of Science, Southern Oregon College of Education, Ashland, Oregon. B.S., University of Oregon; M.S., Oregon State College. High school biology teacher for 20 years; has made experimental studies on both superior and retarded biology students; students included winners of FSA and Westinghouse Talent Search awards. Helped to prepare the present course of study in biology in Oregon. Charter member of NABT; first vice-president in 1956; state membership chairman for Oregon; state chairman of Conservation Project; textbook evaluation committee. Member: AAAS, AIBS, National Science Teachers Association, Oregon Academy of Science, Phi Beta Kappa, Phi Kappa Phi, Pi Lambda Theta. NSTA committee on biology teaching. Winner of NSTA Teacher Award, 1952. Ford Foundation Fellowship, Fund for Advancement of Education, 1953-54. Co-author of monograph, "Selected Procedures for Teaching Biology." Professional articles in *The American Biology Teacher*, *Science Education*, *The Science Teacher*, and *Selected Science Teaching Ideas of 1952*.

Candidate for President-Elect

Enid A. Larson

Biology teacher, Carmel High School, Carmel, California. A.B., M.A. (Zoology), University of California. Microtechnician for 8 years, including 4 years at Stanford University; biology teacher in junior and senior high schools for 15 years; director, illustrated lecture series at Carmel High School; students included winners of FSA and Westinghouse Science Talent Search awards. Member of NABT since 1943; California state membership chairman; second vice-president in 1955. Life member of National Science Teachers Association. Member: AIBS, American Society of Mammalogists, Cooper Ornithological Society, Audubon Society, Nature Conservancy, Northern California School Coordinators Science Curriculum Committee, Pi Lambda Theta, Associate in Sigma Xi. Served on faculty of Workshop on Development of Quantitative Thinking in Science, summer of 1956, Santa Clara County, California. Observer at Hastings Natural History Reservation for 5 summers. NSTA Teacher Award, 1953. Ford Foundation Fellowship, Fund for Advancement of Education, 1954-55. Professional articles in *The American Biology Teacher* and *The Science Teacher*.

Candidate for First Vice-President

Rex Conyers

Biology teacher, University City High School, University City, Missouri. B.S., M.Ed. (Conservation education), University of Missouri. Biology teacher for 18 years; developed one of the first large-scale high school conservation demonstration areas; very active and successful in students' participation in Science Fair competitions; summer camp consultant; instructor in nature recreation in adult education. Charter member of NABT; Missouri state membership chairman, 1950-55; regional chairman of Conservation Project; recorder of conservation section, North Central Work Conference on Biology Teacher, summer 1955. Member: AIBS, AAAS, Missouri Science Teachers Association (past-president), Webster Groves Nature Study Society (president 1955-57), American Nature Study Society. Local representative for ANNS and NABT at St. Louis convention of AAAS in December 1952. Author: "Flight Schedule of Birds, Jackson County, Missouri." Co-author: "Guide to Birding Areas of St. Louis Region." Editor of St. Louis Audubon Society *Bulletin*. Professional articles in *The American Biology Teacher*.

Candidate for First Vice-President

Brother G. Nicholas, F.S.C.

Biology teacher at La-Salle High School, Cumberland, Maryland. B.S., Catholic University; M.Sc., University of Pittsburgh; candidate for Ph.D. at University of Notre Dame at present. High school biology teacher for 7 years; summer teaching at De La Salle College. NABT member since 1950; Maryland state membership chairman since 1952; NABT representative on AAAS cooperative committee on teaching of science and mathematics; assistant editor of *The American Biology Teacher* since 1953; attended national meetings since 1950; health committee, 1950. Member: AAAS, Delaware Natural History Society, Pennsylvania Academy of Science, AIBS, National Speleological Society (currently vice-president), Society of Systematic Zoologists (past-president), National Science Teachers Association. Presented more than 50 papers and lectures at meetings of AAAS, NABT, NSTA, Pennsylvania Academy of Science, and other organizations. Directed excavation of Cumberland Bone Cave, working in conjunction with Carnegie Museum of Pittsburgh. Has studied flora and fauna in 200 caves of eastern U. S. At least 25 articles in *The American Biology Teacher*, *Science*, *Scientific Monthly*, *Scientific American*, *Proceedings of Pennsylvania Academy of Science*, and other journals.

Candidate for First Vice-President

Howard E. Weaver

Assistant Professor of Outdoor Education, University of Illinois, Urbana, Illinois. B.S., Purdue University; M.S. in Ed., Ph.D. (Conservation education), Cornell University. Senior naturalist in Indiana State Park System; extension specialist in conservation education at Texas A & M College for 3 years; also served as consultant in conservation education to Texas schools and colleges; summer staff member of Northern Illinois State College's field campus; coordinates and instructs in outdoor education in present position. Second vice-president of NABT in 1956; chairman of Committee on Affiliations; southwest regional chairman of Conservation Project; active in annual meetings in Cleveland, St. Louis and Berkeley; assisted in New York meeting (1949). Member: AIBS, Conservation Education Association. Author of 2 books, bulletins, circulars, and professional papers.

Candidate for Second Vice-President

Frances L. Hall

High school science teacher, Atlanta, Georgia; currently a graduate student in science education at Teachers College, Columbia University, and a part-time instructor at Barnard College, Columbia University. B.A., Emory University, Atlanta; M.A. (Zoology), University of Arkansas; Master's dissertation: "Studies on Blood Sugars of the Frog." High school science teacher in

Atlanta; graduate student at Columbia University since 1955, holding John Hay Whitney Fellowship in correlation of science and humanities in 1955-56, and a graduate assistantship in science education in 1956-57. Member of NABT; Georgia state chairman of Conservation Project; local chairman for NABT part of AAAS meetings in Atlanta, 1955. Member: AIBS, Georgia Academy of Science.

Candidate for Second Vice-President

Gladys J. Haney

Biology teacher, Ishpeming High School, Ishpeming, Michigan. B.S., M.A., State University of Iowa; advanced study at University of Colorado. Has taught in 5 states; biology teacher at Ishpeming for 13 years; sponsor of Allied Youth at Ishpeming High School; sponsor of Amateur Biologists Club, affiliated with Science Clubs of America; 1955 winners at regional science fair were Ishpeming students; her students have earned numerous science competition awards for many years. NABT member. Member: AIBS, state and national education associations.

Candidate for Second Vice-President

Dorothy Vaughn

Biology teacher, Neodesha, Kansas. B.A. and graduate work at University of Kansas. Junior high and senior high school science teaching for 20 years; sponsor of an active science club whose 1955-56 record included: 2 Westinghouse honorable mentions, winner of Kansas Science Talent Search, 3 grand prize winners at Kansas State Teachers College Fair at Pittsburg, Kansas, 1 Summerfield scholar to the University of Kansas, and 4 members chosen to participate in 1956 Science-Mathematics Camp at University of Kansas. NABT member; Kansas state membership chairman. Member: AAAS, AIBS, NEA, Kansas State Teachers Association, Neodesha Teachers Association, assistant director of Kansas Junior Academy of Science, Phi Sigma.

Candidate for Third Vice-President and National Membership Chairman

Robert Smith

Chairman of biology department. DeKalb High School, DeKalb, Illinois. B.Ed. (Biology), Illinois State Normal University; graduate work at University of Michigan. Biology teacher and coach in Illinois high schools since 1938; teaching assistantship at University of Michigan in 1946; served as Army parasitologist during World War II. Active on NABT committees; third vice-president and national membership chairman in 1955-56; regional membership chairman in 1953; state and regional chairman of Conservation Project; active participant in North Central Conference on Biology Teaching, 1955. Member: AIBS. In Illinois Junior Academy of Science, served as chairman of judging (1941), assistant state chairman (1947), state chairman (1949-51).

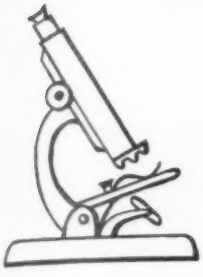
Candidate for Secretary-Treasurer

Paul V. Webster

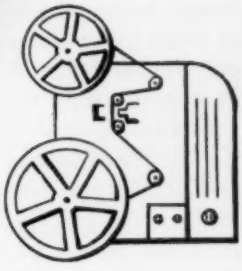
Biology teacher, Bryan High School, Bryan, Ohio. B.A. (Zoology), B.S. in Education, M.A., Ohio State University. High school biology teacher for several years. Active at NABT meetings; secretary-treasurer since 1954; Ohio state membership chairman; steering committee for Southeastern Conference on Biology Teaching, 1954. Life member, National Science Teachers Association. Member: AAAS, AIBS, NEA, Central Association of Mathematics and Science Teachers, American Nature Study Society, Ohio Education Association. Served as president and vice-president of Bryan City Teachers Association. Advisor to Future Teachers of America chapter; state parliamentarian of the sponsors of the FTA.

For the 1957 Nominating Committee:

Rex Conyers, University City, Mo.
Edna Higbee, Pittsburgh, Pa.
Robert McCafferty, Wadsworth, Ohio
Luther West, Marquette, Mich.
Emery L. Will (Chm.) Oneonta, N. Y.



A-V NEWS



EMERY L. WILL
State University Teachers College, Oneonta, New York

Mounting of 2¼ x 2¼ inch transparencies is facilitated with new economy glass binder having built-in masks and a self-sealing glass binder. The Filmosto glass binders utilize precleaned glass, and are available from Karl Heitz, Inc., 480 Lexington Avenue, New York 17, N. Y.

A new 135 mm. telephoto lens now is produced for the Argus C3 camera.

Biologists, particularly those in the northern border states, will be interested in the release of two new 33 1/3 r.p.m. recordings made by Dr. William Gunn, Canadian naturalist. *Songs of Spring* is a 10" record of the representative songs of 25 common Ontario birds. *A Day in Algonquin Park* is a 12" record of natural sounds of forest, marsh and lake in this famous park. Federation of Ontario Naturalists, 1156 Bay Street, Toronto 5, Canada.

The Tri-Simplex microprojector projects microslides onto a wall screen, onto a table top, or projects images of living microorganisms in liquid onto a wall screen. Three objectives may be mounted in the unit at once, for rapid change in magnification. Bausch & Lomb Optical Co., 80101 St. Paul St., Rochester 2, N. Y.

The Universal Photomicrographic Camera, Model U, can be used for macrophotography as well as for the many degrees of magnification possible with various types of microscopes. It can use several different sizes of negatives in color and in black-and-white. Its use has been enhanced recently with the introduction of the Ibscaphot photoelectric exposure meter, which has high sensitivity, rapid operation, and surprising convenience. C. A. Brinkmann & Co., P. O. Box 532, Great Neck, L. I., N. Y.

Now the wide screen advantage of Cinemascope productions may be had by schools and colleges, as different firms announce the release of 16 mm. anamorphic lenses, which may be attached readily to most or all 16 mm. sound projectors. The simultaneous release of several Cinemascope features in the 16 mm. size points up the possibility that our auditoriums may become centers of educational film showings. Victor now produces a 1600-lumen arc 16 mm. sound projector for use outdoors and in auditoriums. The anamorphic lenses are available from: Victor Animatograph Corp. ("Vidoscope"), Davenport, Iowa; J. L. Galef & Son, Inc. ("Vistascope"), 85 Chambers St., New York 7, N. Y.; Bausch & Lomb Optical Co. ("Cinemascope"), 82702 St. Paul St., Rochester 2, N. Y.

Biology teachers who have despaired of being able to effectively darken their classrooms because of Venetian blinds will be interested in the Flexalum Audio-Visual Blinds. Recent tests have indicated that this blind will shut out as much as 30 times more daylight that will a fully-closed conventional blind. Hunter Douglas Corp., 150 Broadway, New York, N. Y.

Elementary science textbook publishers are increasingly interested in the preparation of films and filmstrips to accompany their texts. Latest company to try this method is the D. C. Heath Co., publishers of the Heath Elementary Science Series. Churchill-Wexler Film Productions collaborated with the authors, Herman and Nina Schneider, to produce three ten-minute films which illustrate selected units in the next series: *The Clothes We Wear*, *Pipes in the House*, and *Plants Make Food*. The first two are superior instructional films,

and hold promise for further noteworthy advances in the planning of educational films. All of them move along at an excellent, unhurried pace. D. C. Heath & Co., 285 Columbus Ave., Boston 16, Mass.

Gardening techniques, from seed germination to the breeding of new varieties of food and ornamental plants, are shown graphically in the seven color films currently available for restricted showings from the National Garden Bureau, Room 720, 407 So. Dearborn St., Chicago 5, Ill.

RECENT FILM AND FILMSTRIP RELEASES

CHRISTMAS FOR THE BIRDS. 14 min., sd., color. Motivation of young children to participate actively in winter bird feeding. Wilmer Films, Lebanon, Conn.

SEEDS GROW INTO PLANTS. 11 min., sd., color. Simple explanation of seed germination and early plant development. Elementary schools. Coronet Films, 65 E. Water St., Chicago 1, Ill.

FOSSILS ARE INTERESTING. 11 min., sd., color. The kinds, location and study of fossils; change in living things; unraveling riddles of life in prehistoric times. Elem. and jr. high. Film Associates of California, 10521 Santa Monica Blvd., Los Angeles 25, Calif.

FISH ARE INTERESTING. 11 min., sd., color. Fundamental concepts of biology as applied to the fishes. Elem. and jr. high. Film Associates of California.

REPTILES ARE INTERESTING. 11 min. sd., color. Comparisons of the five living groups of reptiles. Elem. and jr. high. Film Associates of California.

SEA SHELL ANIMALS. 11 min., sd., color. Introduction to the univalves and bivalves; collecting techniques. Elem. and jr. high. Film Associates of California.

LIFE IN THE OCEAN. 15 min. sd., color. An overview of the plant and animal life inhabiting the ocean; very well done. Elem. and jr. high. Film Associates of California.

ANIMAL HOMES. 11 min., sd., color. The homes and home life of the cliff swallow, redwing, ant, spider, gallfly, mole, gopher, opossum and coatimundi. Primary and intermediate grades. Churchill-Wexler Film Productions, 801 North Seward St., Los Angeles 28, California.

SEIFRIZ IN PROTOPLASM. 26 min., sd., b & w. Dealing principally with the slime mold, Physarum polycephalum, this is a film designed to stimulate thinking about certain properties of and experiments with protoplasm. Topics include microdissection, anesthesia, toxicity, stimulants, fusion, streaming and torsion. Shows the work of Dr. William Seifriz at the University of Pennsylvania. Undergraduate college courses in the biological and bio-physical sciences. Educational Film Library Association, 345 East 46 St., New York 17, N. Y.

HANDLING LABORATORY ANIMALS. 20 min., sd., b & w. Filmed in England, at the National Institute for Medical Research, this film demonstrates recommended methods of handling 12 common laboratory animals. Animal Welfare Institute, 350 Fifth Ave., New York 1, N. Y.

THE BEAVER MAKES A COMEBACK. 16 min., sd., color. Filmed in the James Bay area of Canada, this is an account of a government-sponsored beaver conservation project. It shows the development of the project, and it contrasts the economic conditions of the Indian trapper families before and after the project. Jr. high and up. National Film Broad of Canada, Suite 658, 630 Fifth Ave., New York 20, N. Y.

FOOD. Color filmstrip covering the types of food, food as a source of energy, and tabular analysis of common foodstuffs. Marian Ray, 36 Villiers Ave., Surbiton, Surrey, England.

THE VANISHING PRAIRIE filmstrip series. Six filmstrips in color, with about 50 frames each. Integrated series of captioned pictures from Disney's True-Life Adventure feature, with filmstrip titles: *The American Prairie*, *The American Buffalo*, *Prairie Dogs*, *The Mountain Lion*, *Coyotes and Other Prairie Animals*, and *Birds of the Prairie*. Useful for all age levels. Encyclopedia Brittanica Films, 1150 Wilmette Ave., Wilmette, Ill.

THE LIVING DESERT filmstrip series. Six filmstrips in color, with about 48 frames each. An organized series of captioned pictures from Disney's True-Life Adventure feature, with filmstrip titles: *The Great American Desert*, *Survival in the Desert*, *Mammals of the Desert*, *Reptiles of the Desert*, *Small Creatures of the Desert*, and *Plant Life of the Desert.*

Useful from fourth grade on up. Encyclopedia Brittanica Films.

THE AFRICAN LION filmstrip series. Six filmstrips in color, with about 48 frames each. An integrated presentation of captioned pictures from the "still" cameras on location at the filming of Disney's True-Life Adventure feature, with filmstrip titles: *King of Beasts, African Plain, Larger Animals of Africa, Antelopes and Smaller African Animals*, and *Elephants in Africa*. Useful from fourth grade on up. Encyclopedia Brittanica Films.

Books for Biologists

The Biology of Man. Hensill, J. S. The Blakiston Co., Inc., New York, 440 pp. 1954, $5.50.

Not an attempt to introduce the student to the whole spectrum of biology, but only to present the major principles of animal biology as they apply to man.

Microbiology—An Introduction. Gray, E. Philosophical Library, Inc., New York, 175 pp. 1955, $3.75.

A simple introduction to Microbiology covering the viruses, the bacteria, the yeasts, the algae and others. Intended as a foundation for subsequent specialized study.

Introduction to Vertebrate Embryology. Shumway, W., and Adamstone, F. B. John Wiley & Sons, Inc., New York, 389 pp. 1954.

The fifth edition of a widely used text. The book is organized on a comparative basis, and the general account of the developmental process is supplemented by detailed material relating to the amphioxus, the frog, the chick, and man. The material is treated from morphological and physiological viewpoints.

Evolution of the Vertebrates. Colbert, E. H. John Wiley & Sons, Inc., New York, 479 pp. 1955, $7.50.

Evolution of the Vertebrates offers a fascinating account of the history, characteristics and life of the backboned animals. It is the story of vertebrate evolution as revealed by fossil evidence. Specially drawn illustrations amplify the written descriptions.

The Mammals of Minnesota. Gunderson, H. L. and Beer, J. R. University of Minnesota Press, Minneapolis, 190 pp. 1953, $3.50.

All the wild species that have been identified at any time within the borders of Minnesota are described. Keys to all the classifications are given. Step-by-step directions tell how to trap, collect, and prepare specimens. A section on geography explains how the terrain, vegetation, and climate in the various regions affect the mammal populations.

General Microbiology. Walter, W. G. and McBee, R. H., D. VanNostrand Co., Inc., New York, 345 pp. 1955, $4.75.

The authors of this rather complete revision of *General Bacteriology* written by the late Professor D. B. Swingle, follow Swingle's philosophy of presenting this phase of biology in such a manner as to encourage a beginning student to relate his daily living to the activities of the microbial world and at the same time to acquire a scientific approach which would permit him to pursue more advanced courses in microbiology.

Isotopic Tracers. Francis, G. E., Mulligan, W., and Wormall, A. John de Graff, Inc., New York, 306 pp. 1954, $7.00.

Here is a concise but adequate treatment of the theoretical principles underlying the preparation and measurement of radioactive and stable isotopes, and their use in biology. It also contains detailed instructions for a course of practical exercises. Much valuable physical data are collected here for the first time.

An Introduction to the Biology of Yeasts. Ingram, M. Pitman Publishing Corp., New York, 273 pp. 1955, $5.00.

This book is intended for the student or research worker who, beginning the study of the yeasts, wishes for a general account of what they are and what they do. It gives an up-to-date account chiefly from the physiological point of view.

The Major Features of Evolution. Simpson, G. G. Columbia University Press, New York, 434 pp. 1953, $7.50.

The Major Features of Evolution presents a general review of the history of like as seen in the fossil record and interprets the evolution of life in the light of the most recent data from paleontology, genetics, systematics, and related sciences.

The Metabolism of Algae. Fogg, G. E. John Wiley & Sons, Inc., New York, 149 pp. 1953, $2.00.

In this book the author brings together information scattered through a variety of scientific publications into a general account of the metabolism of algae which should interest students of botany, microbiology and biochemistry.

The Microtomist's Formulary and Guide. Gray, P. The Blakiston Co., Inc., New York, 794 pp. 1954, $10.50.

A treatise on the art of making microscope slides from biological specimens and a classified list of the formulas and techniques used in this art.

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Books for Biologists

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TIME COUNTS. Watkins, H. Philosophical Library, New York, 274 pp. 1954, $4.75.

This important and unusual book deals not only with the history of the various campaigns for time reform, but also tells the immensely interesting story of the calendar as one of man's earliest inventions and its handling (and mishandling) by many people through the centuries.

THE BIOLOGY OF THE AMPHIBIA. Noble, G. K. Dover Publications, Inc., New York, 577 pp. 1955, $4.95.

A comprehensive treatise on the biology of the amphibia.

THE HERRING GULL'S WORLD. Tinbergen, N. Frederick A. Praeger, New York, 255 pp. 1954, $4.00.

This book is an account of the investigations by a famous Dutch scientists of the life history and habits—and particularly the breeding habits—of the herring gull, familiar and widespread bird of practically all the coasts of the northern half of the world.

BACK OF HISTORY. Howells, W. W. Doubleday and Co., Inc., New York, 384 pp. 1954, $3.50.

For anyone who might like to know the story of the human background in an understandable and most general way.

GENETICS AND METABOLISM. Wagner, R. P., and Mitchell, H. K. John Wiley & Sons, Inc., New York, 444 pp. 1955, $7.50.

Asserting the theory that inheritance is the transmission of like forms of metabolism, this book gathers together many facts and ideas from the fields of genetics and biochemistry, as well as from physiology, cytology, and embryology. It is the only such correlation of genetics and metabolism available today.

FIELDIANA: ZOOLOGY, A Continuation of the Zoological Series of Field Museum of Natural History, Vol. 37, Chicago Natural History Museum, Chicago, 728 pp. 1955, $10.00.

This volume, honoring Karl Patterson Schmidt, contains contributions not only from the various Divisions of the Department of Zoology but also from the Division of Paleontology.

MARINE TROPICALS. Fisher, E. L. Sub-Marine Studios, Miami, Florida, 55 pp. 1954, $1.50.

A comprehensive handbook explaining a new successful method for maintaining the brilliantly colored marine fish and animals. Illustrated.

GLASS REINFORCED PLASTICS. Morgan, P. Philosophical Library, Inc., New York, 248 pp. 1954, $10.00.

Gathered together in this volume are the essential facts involving the organic chemistry, design, moulding processes and major applications of glass reinforced plastics for the general reader, yet explained in sufficient detail for the specialist.

MANAGEMENT OF ADDICTIONS. Podolsky, E. Philosophical Library, Inc., New York, 413 pp. 1955, $7.50.

This volume is a discussion of addictions to alcohol and various drugs by leading authorities in the field. The mechanisms of addiction are thoroughly explored and methods of therapy are presented in detailed form.

MOSQUITOES—THEIR BIONOMICS AND RELATION TO DISEASE. Horsfall, W. R. Ronald Press Co., New York, 723 pp. 1955, $16.00.

This volume provides a complete summary of the information available on the bionomics of the subfamily of mosquitoes. It provides an easy reference for specialists in mosquito research.

MOSQUITO CULTURE TECHNIQUES AND EXPERIMENTAL PROCEDURES. Trembley, H. L. Bulletin No. 3, American Mosquito Control Assn., Inc., 73 pp. 1955.

A brief, comprehensive bulletin on the rearing, development, behavior and literature of the mosquito.

LIFE IN LAKES AND RIVERS. Macan, T. T., and Worthington, E. B. Frederick A. Praeger, Inc., New York, 272 pp. 1954, $4.50.

Dr. Macan and Dr. Worthington reveal the fascination of the world of fresh water and portray the plants and animals in their full beauty and their natural colors.

TOBACCO DICTIONARY. Jahn, R. Philosophical Library, Inc., New York, 199 pp. 1954, $5.00.

The *Tobacco Dictionary* should bring to the reader interesting, curious and necessary facts relating to the history, manufacture and use of tobacco. It gives information which has previously been scattered and difficult for the average person to find.

EMBRYOGENESIS IN PLANTS. Wardlaw, C. W. John Wiley & Sons, Inc., New York, 381 pp. 1955, $7.00.

A comprehensive survey—the first of its kind—in which the author has described, illustrated, and discussed the embryological development in all classes of plants, from algae to angiospermae.

ILLUSTRATED GAMES AND RHYTHMS FOR CHILDREN. Geri, F. H. Prentice-Hall, Inc. Publishers, New York, 196 pp. 1955, $2.95.

In this book the author presents clear, concise, graphic ideas of activities for children in the age group of the lower elementary grades. Should furnish teachers, instructors, and parents with readily understandable directions for many profitable activities.